

ABSTRACT

Terrestrial vertebrate monitoring was conducted at Channel Islands National Park in 1995. This was the third year that the island fox, deer mice and reptiles and amphibians were sampled on Santa Barbara, East, Middle, and West Anacapas and San Miguel Islands. Population and density estimates were estimated for three island fox grids and seven deer mice grids. Population index values were calculated for the island night lizard (*Xantusia riversiana*) on two grids, and for the alligator lizard (*Gerrhonotus multicarinatus*) on three grids. Weight/length regressions were performed on the same two species.

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Island Fox

Introduction

Island fox (*Urocyon littoralis*) monitoring continued on San Miguel Island (SMI) in 1995. This was the third year that island fox were monitored on Willow Canyon (WC) and San Miguel Hill (SMH) grids, and the second year of monitoring at the Dry Lake Bed (DLB) grid (Figure 6). Density and population estimates were estimated for each of these grids.

Materials and Methods

In 1995 fox monitoring was conducted on WC grid from 17-25 July, on SMH grid from 7-15 August, and on DLB grid from 21-29 August. Trapping and marking protocols were identical to those described in Schwemm 1993 and 1994.

Estimates of density were obtained using standard methods for island fox (Roemer et al. 1994). Density is calculated as $D = N/A(W)$, where N = population estimate, and $A(W)$ = the naïve estimate of grid area (A), to which a boundary strip (W) has been added to adjust for trapping of animals whose home range extends outside the grid. The boundary strip width (W) is calculated as $1/4$ MMDM (Mean Maximum

Distance Moved) for all animals trapped. The program CAPTURE (White et al. 1982) was used to select the population estimation model, the population estimate (N), and the MMDM calculation. The MMDM estimate is then halved and added to the length of each side of the grid in order to obtain area $[A(W)]$. Pups are excluded from the population estimate due to their close association with adults and their potential biasing effect on MMDM (Roemer et al. 1994).

Results and Discussion

In 1995, 88 individuals, including pups, were trapped on 3 grids (Table 1). Thirty-six of these were new animals, which had never been previously tagged. Density estimates for SMH and DLB were similar to one another (5.2 foxes/km^2 and 4.7 foxes/km^2 , respectively) whereas the estimate for WC was higher (11.1 foxes/km^2). The population estimates for SMH and DLB were similar ($N = 19$, $SE = 1.5$ and $N = 18$, $SE = 4.1$ respectively), while the estimate for WC was again somewhat higher ($N = 41$, $SE = 4.7$).

The 1995 calculated average weights for adult foxes and pups are presented in table 2. This data is of little interest by itself, but will be useful in comparison with other years when correlated with annual variation of prey resources.

In 1995, 3 foxes were trapped on the SMH grid that were initially marked with collars during the design phase of the vertebrate monitoring protocol (Fellers et al. 1988). The last time any fox were collared on SMI was in 1989. One fox was collared in 1988, and the second was

collared in 1989. The third collared fox was also trapped in 1993. At this time the original numbers were unreadable, and we assigned the fox a new identification code (#50). Therefore, this fox (#50) is 7 years old. Table 3 shows the current estimated ages of these 3 previously collared animals.

Island Deer Mouse

Introduction

Island Deer Mouse (*Peromyscus maniculatus subsp.*) monitoring continued throughout 1995. This was the third year of the mouse monitoring program. Of the 7 grids, 5 were monitored twice, once in the spring and once in the fall, while the remaining 2 were monitored only in the fall. Density and population estimates were obtained from these grids. In addition, mice were trapped on SMI in September to determine the prevalence of hanta virus, a density estimate was also obtained (T. Graham pers. comm.)

Material and Methods

Deer mouse sampling methods are thoroughly described in the monitoring handbook (Fellers et al. 1988). Currently there are 7 grids which are monitored on a bi-annual basis: 2 grids on Anacapa Island (AI, Figure 3), 2 on Santa Barbara Island (SBI, Figure 4) and 3 on SMI (Figure 5). For each grid, 100 traps are placed in a 10×10 grid with a trap spacing of 7 meters. Each trap is baited with rolled oats and the grid is opened for three consecutive nights. On their first capture, each animal is weighed, sexed, aged and marked with an ear tag. Capture history data is entered into the program CAPTURE (White et al.

1982), which selects an appropriate estimation model from which it calculates population size and density. The data is also entered into the program ACCESS, for long-term database management.

Results and Discussion

Deer mice on the Channel Islands have been found to show definite breeding seasons, with the majority of reproduction occurring during the spring and summer months (Collins et al. 1979). The 1995 data indicates that at least two litters were produced. The normal gestation period range is from 22-35 days, with the average being 26 days, and mice are considered in their juvenile pelage from birth to 11 weeks, while sub-adults are from 11-21 weeks (Collins et al. 1979). From the results we can estimate that the first litter was produced in mid-late April. Spring trapping results from Middle Anacapa Island (MAI) show that 3 of 6 (50%) females captured were either pregnant or lactating, while at the SMI-Nidever (NI) grid, 12 of the 25 (48%) females captured were either pregnant or lactating. In the fall, 17 sub-adults were captured at SMI-NI, while 9 sub-adults were captured at MAI (Table 5). In addition, mice were trapped on two grids on SMI from 3-5 September to determine the prevalence of hanta virus. During these trapping periods, age data was not consistently collected. However, of the 247 individual mice trapped at the Airstrip grid, 24 were aged as juvenile. In addition, of the 118 individuals trapped at the Helipad grid, 9 were aged as juvenile. Also, juveniles were captured at SMI-WC and AS grids in October, and a single juvenile was captured on MAI in

November (Table 5). Thus a second litter was produced sometime from late August through September.

For the 1995 mouse trapping, comparisons between spring and fall sessions can be made for 5 of the 7 mouse grids (Table 4). The results from all grids show an increase in population size from spring to fall (Table 4). This is consistent with earlier island deer mouse population estimates (Schwemm 1993, Collins et al. 1979). This increase is expected after the peak spring reproductive period due to the recruitment of juveniles into the population during the summer and fall.

Average weights by age class are presented in Table 5. As expected, weights are highest in the spring when fewer animals are present and food is abundant. Throughout the remainder of the year as more animals are recruited into the population and as the food supply decreases, the average weights tend to be lower.

A slighter higher ratio of males to females has generally been recorded for deer mice in both wild and laboratory experiments (Collins et al. 1979). In 1995, 754 individual mice were captured from all age classes (Table 6). Table 7 shows that 58 percent of the adult age class were males, while Table 8 shows that 59 percent of the sub-adult age class were males.

From 11-13 October three grids were trapped on SMI, allowing for a habitat comparison. These grids represent three different habitat types: a grassland, a grassland-shrub habitat, and a lupine-iceplant habitat. Although deer mice inhabit a variety of habitats, they tend to prefer

areas with dense cover, mainly because these areas offer a more abundant food supply and better cover for predator avoidance. Considering the difference in habitat types, there was very little difference in the number of individuals captured (range 140-157; Table 4). Nidever Canyon (lupine-iceplant) had the largest population (N=157), followed by the Airstrip grid (grassland-shrub, N=145) with Willow Canyon (grassland) having the fewest number of individuals (N=140). During this same fall trapping season, mice numbers on SBI, MAI, and WAI were much lower (Table 4).

Amphibian and Reptiles

Introduction

In 1995, 8 reptile and amphibian transects on 5 different islands were sampled by means of cover boards. Of the 8 transects, 5 were sampled twice, while the other 3 were sampled only once (Table 10). Methods used for sampling amphibians and reptiles are described in the monitoring handbook (Fellers et al. 1988).

Results and Discussion

A population index was calculated for lizard species on transects which were checked at least twice throughout the year. The population index values are calculated by dividing the total number of animals found on a transect in a sampling year (this includes all animals which escaped before handling) by the total number of boards checked (Fellers et al. 1988). Table 9 shows the population indices for transects

which were checked in both the spring and fall of 1995.

Short term changes in population indices can be examined by comparing the current with the previous year's population index by using a chi-square contingency analysis (Fellers et al. 1988). This tests the hypothesis that the frequencies of occurrences of one variable (transect) are independent of the frequencies of the second variable (transect) (Zar 1974). Thus the null hypothesis would be, for each transect (independently), the lizard species will be found in the same proportions in successive years. From 1994 and 1995, comparisons were made for SBI night lizard (*Xantusia riversiana*) Cave-Middle Cyn. transect (CM) and Terrace Grassland (TG) transect, also for the alligator lizards (*Gerrhonotus multicarinatus*) of Middle Anacapa Island (MAI) and West Anacapa Island (WAI) transects. In both cases the null hypothesis was not rejected, i.e. the night lizard was found in the same proportions in successive years at both CM and TG transects. Additionally, alligator lizards were found in the same proportions in successive years at the MAI and WAI transects.

The handbook also calls for a calculation of weight-length regressions. The mass of an animal relative to its length can provide an indication of its health, because healthier animals of a given length are likely to weigh more. Thus, higher regression coefficients should indicate healthier animals. Because weight has a curvilinear relationship with body length, it is appropriate to calculate the regressions as weight versus cube root of length. This approach provides a more linear relationship (Zar 1974).

The monitoring handbook directs that the current years regression coefficients be compared with the previous years. However, the monitoring handbook does not indicate that there needs to be a certain number of individuals captured before a weight-length regression is attempted. Because weight-length regressions are meant to be an indication of the overall general health of the population, it is assumed here that there needs to be at least 2 samples taken in one year and also that there needs to be a certain number of individuals ($N = 12$) to adequately represent the population. Two samples per year is required because the prey base will probably change throughout the year, which could have a significant impact on the lizards size/health. The monitoring handbook does not specify whether regressions should be done for each species per island or per transect. In cases where enough data is available for analysis, regressions are presented for each species spring and fall monitoring are set for roughly the same time each year, without considering if one or two storms have just occurred. Therefore, our sampling efforts may not be providing an accurate estimate of salamander abundance. Table 10 shows the number of salamanders found during each sampling period.

per island. Figures 1 and 2 show regressions for 1995. Regression coefficients were obtained using the computer program SYSTAT.

Trapping for the Pacific slender salamander (*Batrachoseps pacificus*) is problematic, and data interpretation is difficult for a number of reasons. The monitoring protocols state that "Salamanders can be censused only when the ground under the cover board is sufficiently moist. It would be best if one or two storms occur just prior to checking the boards". In addition, several variables will determine the amount of moisture in the soil, and different transects in the different habitat types will support salamanders for varying periods of time (Schwemm 1994). In general, sampling periods for

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Table 1. Island fox monitoring results, San Miguel Island, Channel Islands National Park, 1995.

	Willow Canyon	San Miguel Hill	Dry Lake Bed
Trap Nights	6	6	6
Individuals caught	44	26	18
Total adults	33	18*	13
Total pups	11	8	5
CAPTURE model ¹ used	M(h)	M(bh)	M(h)
Population estimate (SE)	41 (4.7)	19 (1.5)	18 (4.1)
Density estimates w/out pups	11.1/km ²	5.2/km ²	4.7/km ²

¹M(bh) = variable probability removal estimation

M(h) = jackknife estimator

* = An additional four (not counted here) were first trapped on Willow Canyon grid

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Table 2. Comparisons of calculated average weights for adult and pup foxes by year, sex, and grid, at WC, SMH, and DLB grids, 1995.

<u>Grid/Yr.</u>	<u>Sex</u>	<u># of animals</u>	<u>Avg. Weight, kg.</u>	<u>Std. Dev.</u>
Willow Canyon	F	18	2.06	0.3346
	M	14	2.37	0.2813
	P	11	1.27	0.2687
San Miguel Hill	F	9	2.04	0.1740
	M	9	2.24	0.3101
	P	8	1.66	0.4241
Dry Lake Bed	F	6	2.23	0.3051
	M	7	2.22	0.2157
	P	5	1.44	0.2510

Table 3. Calculated ages of fox caught during the initial study phases and recaptured in 1995.

Collar #	Date first caught*	Age in years*	Calculated age this study
1113	10/11/88	0.5	7.5
1118	1/9/89	2.5-3.5	8.5-9.5
0050	**	**	min. age = 7

* from G. Fellers, unpublished data

**When this animal was first caught in 1993 the numbers on the collar were not readable and the number 50 was assigned to the animal. 1989 was the last time that collars were placed on the fox of San Miguel Island, thus at a minimum this animal is seven years old.

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Table 4. Deer mouse captures, density and population estimates, 1995.

Island	Date	Grid/ Habitat Type	# of Individuals Captured	Estimated Density/ha, (s.e.)	Population Estimate, (C.I.).
SMI	8-10 Feb.95	Airstrip (Grassland-shrub)	35	67.9, (16.5)	37, (36-49)
SBI	1-3 Mar. 95	Terrace Coreopsis	3	*	*
WAI	28-30 Mar. 95	Grassland	4	*	*
MAI	1-3 Apr. 95	Grassland	17	47.2, (27.7)	19, (18-33)
SMI	12-14 Apr. 95	Nidever Cyn. (Lupine - iceplant)	49	131, (62.4)	65, (53-113)
SMI	11-13 Oct. 95	Willow Cyn. (Grassland)	140	327, (65.7)	240, (216-272)
SMI	11-13 Oct. 95	Airstrip (Grassland - shrub)	145	419.8, (177)	216, (172-329)
SMI	11-13 Oct. 95	Nidever Cyn. (Lupine-iceplant)	157	316.9, (115.7)	211, (187-264)
WAI	1-3 Nov. 95	Grassland	91	203, (134)	122, (102-182)
MAI	1-3 Nov. 95	Grassland	75	157, (219)	127, (89-273)
SBI	7-9 Nov. 95	Terrace Coreopsis	31**	*	*
SBI	7-9 Nov. 95	Terrace Grassland	12	*	*

* = no estimate

** = of 31 individuals, only 2 recaptures

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Table 5. Deer mouse average weights (grams), by age class, sex and grid, 1995.

Island/Grid	Date	Adult Weights (# of Individuals)		Sub-Adult Weights (# of Individuals)		Juvenile Weights (# of Individuals)	
		Female	Male	Female	Male	Female	Male
SMI-AS	8-10 Feb. 95	19.8 (20)	20.4 (15)				
SBI-TC	1-3 Mar. 95	20.8 (1)	23.5 (2)				
MAI	1-3 Apr. 95	29.6 (6)	24.3 (11)				
SMI-NI	12-14 Apr. 95	25.6 (25)	24.2 (24)				
SMI-WC	11-13 Oct. 95	19.2 (44)	18.8 (45)	15.0 (21)	15.8 (25)	13.6 (2)	14.7 (3)
SMI-AS	11-13 Oct.95	19.0 (35)	18.5 (59)	14.8 (29)	15.5 (20)		13.8 (2)
SMI-NI	11-13 Oct. 95	19.0 (65)	19.6 (74)	15.3 (7)	16.1 (10)		
WAI	1-3 Nov.95	21.0 (25)	20.4 (31)	16.0 (16)	16.5 (19)		
MAI	1-3 Nov.95	20.7 (25)	19.1 (40)	15.3 (7)	16.7 (2)	15.0 (1)	
SBI-TC	7-9 Nov.95	17.2 (7)	20.8 (4)	15.8 (3)	15.8 (17)		
SBI-TG	7-9 Nov. 95	15.4 (1)	18.5 (7)		18.8 (4)		

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Table 6. Sex ratios for Deer Mice from Channel Islands National Park, 1995.

Island/Grid	N	Male	Female	Percent Male	Percent Female
SMI-AS	180	96	84	53	47
SMI-NI	205	108	97	53	47
SMI-WC	140	73	67	52	48
MAI	92	53	39	58	42
WAI	91	50	41	55	45
SBI-TC	34	23	11	68	32
SBI-TG	12	11	1	92	8
Total	754	414	340	62	38

Table 7. Sex ratios for adult age class of Deer Mice from Channel Islands National Park, 1995.

Island/Grid	N	Male	Female	Percent Male	Percent Female
SMI-AS	129	74	55	57	43
SMI-NI	188	98	90	52	48
SMI-WC	89	45	44	51	49
MAI	82	51	31	62	38
WAI	56	31	25	55	45
SBI-TC	14	6	8	43	57
SBI-TG	8	7	1	88	12
Total	566	312	254	58	42

Table 8. Sex ratios for sub-adult age class of Deer Mice from Channel Islands National Park, 1995.

Island/Grid	N	Male	Female	Percent Male	Percent Female
SMI-AS	49	20	29	41	59
SMI-NI	17	10	7	59	41
SMI-WC	46	25	21	54	46
MAI	9	2	7	22	78
WAI	35	19	16	54	46
SBI-TC	20	17	3	85	15
SBI-TG	4	4	0	100	0
Total	180	97	83	59	41

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Table 9. Locations, dates, species, and index values for lizards on Channel Islands National Park, 1995.

Island - Transect	Date(s)	Species	# of Lizards	Population Index Value*
SBI-TG	3/95	XR	6	.10
	11/95	XR	5	
SBI-CM	3/95	XR	32	.44
	11/95	XR	16	
SMI-AS	2/95	GM	15	.17
	10/95	GM	5	
WAI	3/95	GM	1	.06
	11/95	GM	6	
MAI	4/95	GM	2	.05
	11/95	GM	4	

* Population Index = # of lizards captured divided by the number of coverboards checked

Table 10. Number of lizards found on each transect in 1995.

			Species				
Island	Date	Site	BP	GM	SO	US	XR
SMI	2/8/95	AS	8	15	5		
		WC	11				
	2/9/95	NI	2				
EAI	2/22/95	IP	3	1			
		LH	16	6			
SBI	3/1/95	TG					6
		CM					32
WAI	3/30/95	WI	12	1			
MAI	4/2/95	MI	3	2			
SMI	10/11/95	AS		5	1		
WAI	11/1/95	WI		6		1	
MAI	11/3/95	MI	1	4		2	
SBI	11/8/95	TG					5
		CM					16

BP = *Batrachoseps pacificus*, Pacific Slender Salamander

GM = *Gerrhonotus multicarinatus*, Southern Alligator Lizard

SO = *Sceloporus occidentalis*, Western Fence Lizard

US = *Uta stansburiana*, Side-blotched Lizard

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XR = *Xantusia riversiana*, Island Night Lizard

Figure. 1 1995 San Miguel Island alligator lizard weight-length regression

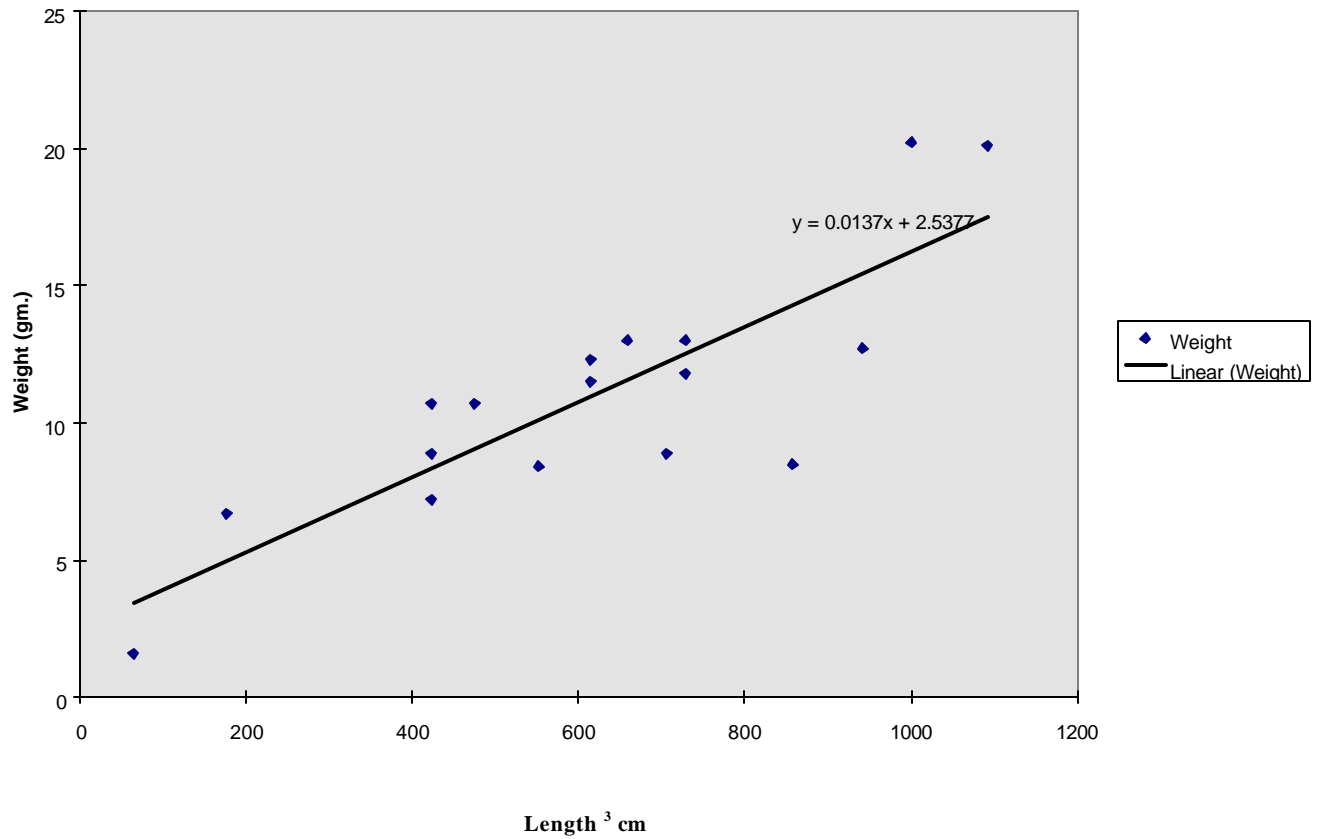
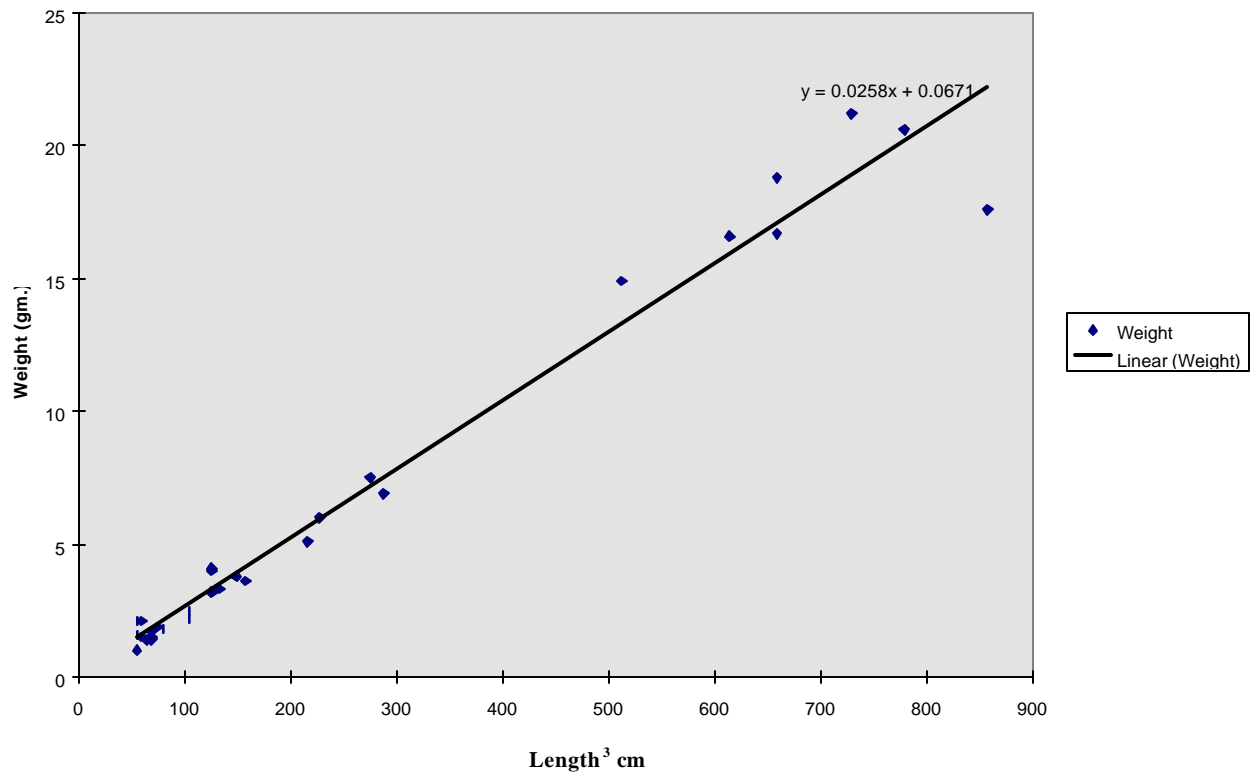


Figure 2. 1995 Santa Barbara Island island night lizard weight-length regression



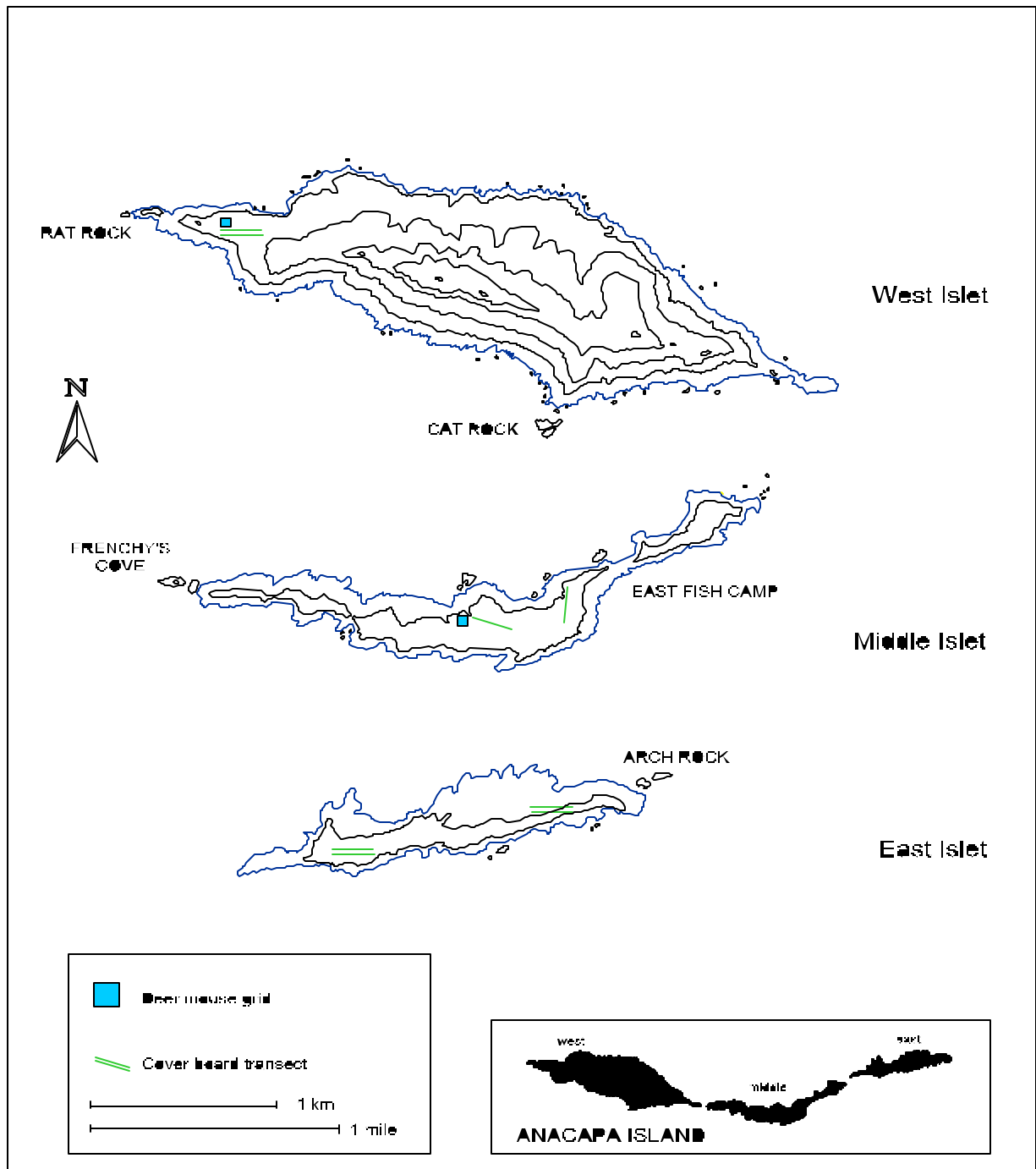


Figure 3. Deer mouse sampling grids and amphibian/reptile sampling transects on Anacapa Island, California.

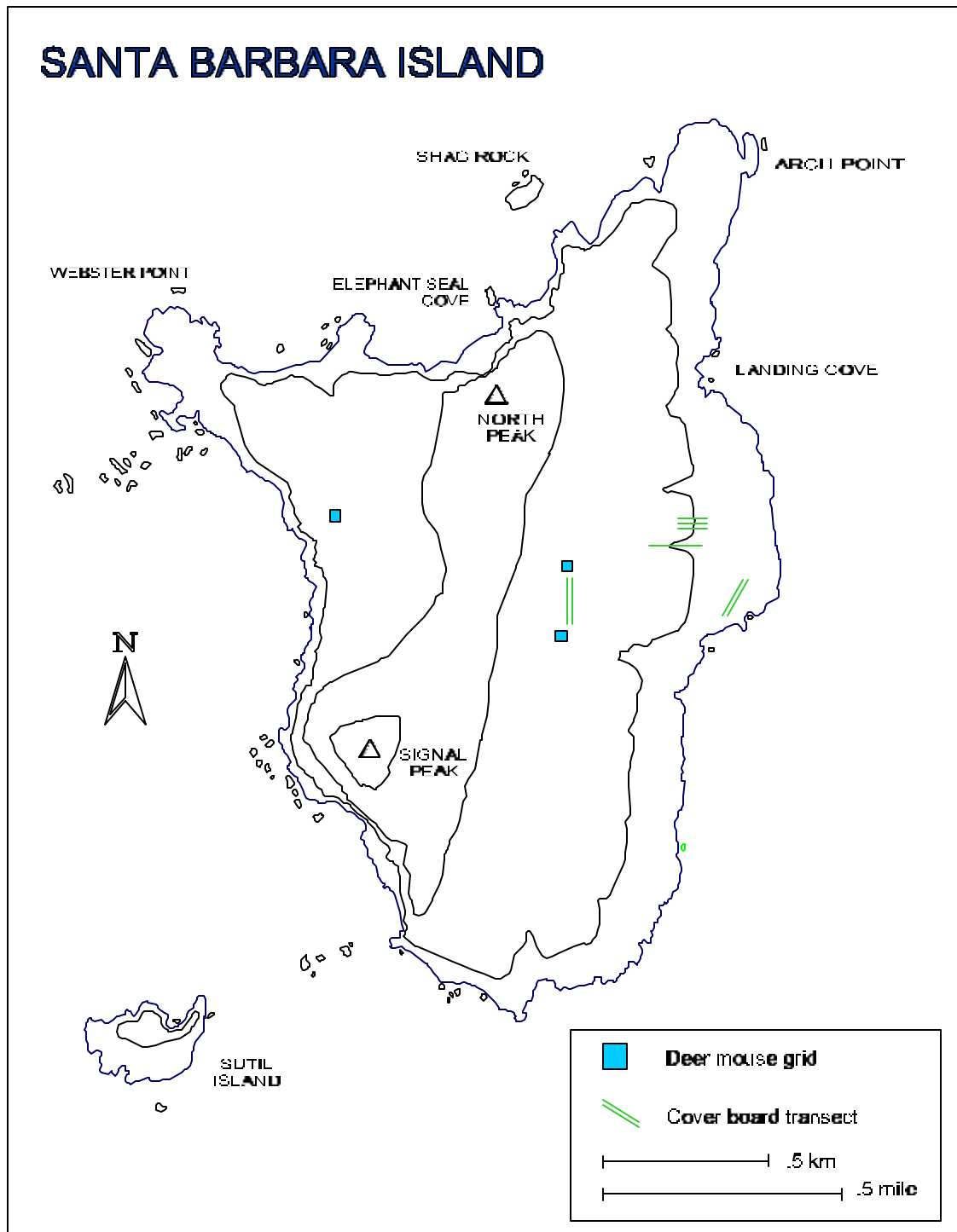


Figure 4. Deer mouse sampling grids and amphibian/reptile sampling transects on Santa Barbara Island, California.

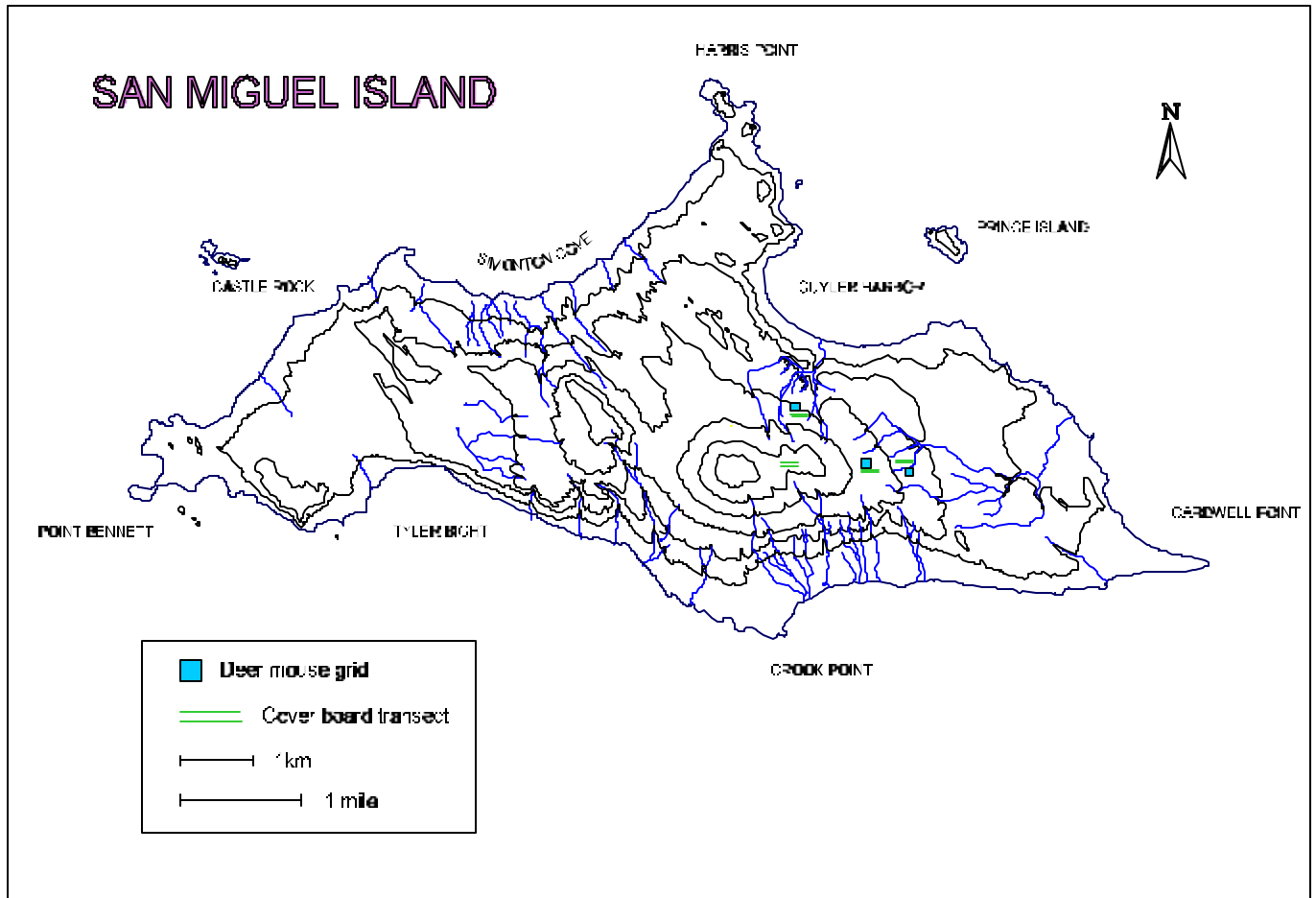


Figure 5. Deer mouse sampling grids and amphibian/reptile sampling transects on San Miguel Island, California.

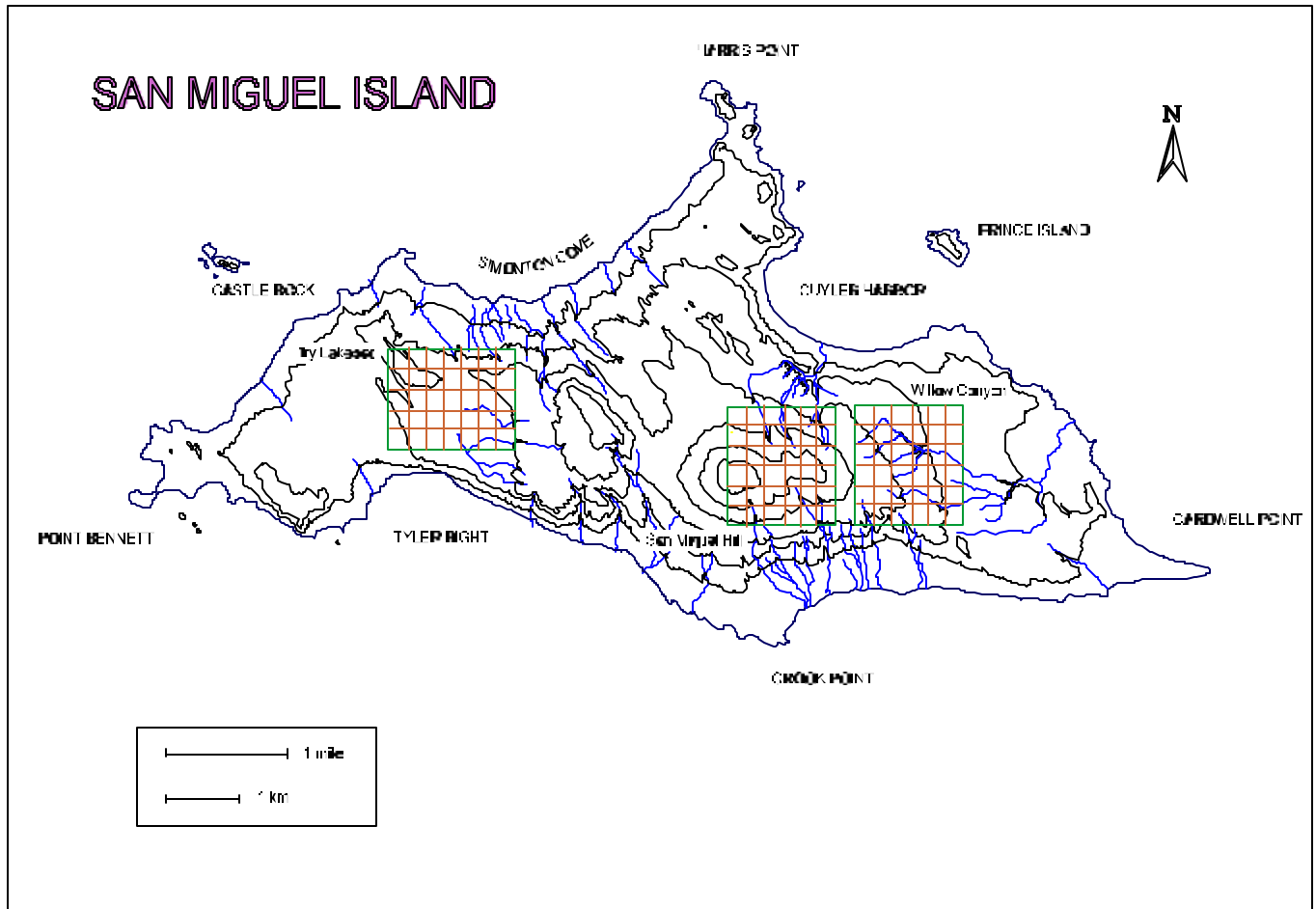


Figure 6. Island fox sampling grids on San Miguel Island, California.